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Report No: ICR0000686

IMPLEMENTATION COMPLETION AND RESULTS REPORT  
(IBRD-41790)

ON

A LOAN

IN THE AMOUNT OF US\$325 MILLION

TO

THE PEOPLE'S REPUBLIC OF CHINA

FOR

THE WANJIAZHAI WATER TRANSFER PROJECT

December 21, 2007

Rural Development, Natural Resources & Environment Sector Unit  
Sustainable Development Department  
East Asia and Pacific Region

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## CURRENCY EQUIVALENTS

(Exchange Rate Effective December 20, 2007)

Currency Unit = RMB Yuan

RMB Yuan 1.00 = US\$0.135

US\$1.00 = 7.39 RMB Yuan

### Fiscal Year

January 1 – December 31

## ABBREVIATIONS AND ACRONYMS

CAS	Country Assistance Strategy
CS	Consumer Surplus
EPB	Environmental Protection Bureau
GMT	General Main Tunnel
GW	Ground Water
ICR	Implementation Completion and Results Report
IP	Implementation progress
ISR	Implementation Status Report
M&E	Monitoring and Evaluation
MVW	Marginal Value of Water
MWR	Ministry of Water Resources
NCP	North China Plain
NPWT	National Programme for Water Transfer
PDO	Project Development Objective
QAG	Quality Assurances Group
SAR	Staff Appraisal Report
SMT	South Main Tunnel
TVEs	Township and Village Enterprises
UFRBC	Upper Fen River Basin Corporation
WWP	Wanjiashai Water Program
WWTP	Wanjiashai Water Transfer Project
WTP	Willingness-to-Pay
YRCC	Yellow River Conservancy Commission
YRDPC	Yellow River Diversion Project Corporation

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**China**  
**Wanjiashai Water Transfer Project**  
**Implementation Completion and Results Report**

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**Maps: IBRD 28136**

<b>A. Basic Information</b>			
Country:	China	Project Name:	CN-Wanjiashai Water
Project ID:	P036405	L/C/TF Number(s):	IBRD-41790
ICR Date:	04/16/2008	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	PRC
Original Total Commitment:	USD 400.0M	Disbursed Amount:	USD 324.6M
<b>Environmental Category: A</b>			
<b>Implementing Agencies:</b> Yellow River Diversion Project Co			
<b>Cofinanciers and Other External Partners:</b>			

<b>B. Key Dates</b>				
Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	09/09/1994	Effectiveness:	11/21/1997	11/21/1997
Appraisal:	10/18/1996	Restructuring(s):		
Approval:	06/03/1997	Mid-term Review:		
		Closing:	06/30/2003	06/30/2007

<b>C. Ratings Summary</b>	
<b>C.1 Performance Rating by ICR</b>	
Outcomes:	Moderately Unsatisfactory
Risk to Development Outcome:	Substantial
Bank Performance:	Moderately Unsatisfactory
Borrower Performance:	Moderately Satisfactory

<b>C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)</b>			
Bank	Ratings	Borrower	Ratings
Quality at Entry:	Unsatisfactory	Government:	Moderately Satisfactory
Quality of Supervision:	Moderately Satisfactory	Implementing Agency/Agencies:	Moderately Satisfactory
<b>Overall Bank Performance:</b>	Moderately Unsatisfactory	<b>Overall Borrower Performance:</b>	Moderately Satisfactory

<b>C.3 Quality at Entry and Implementation Performance Indicators</b>			
Implementation Performance	Indicators	QAG Assessments (if any)	Rating
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	Satisfactory

Problem Project at any time (Yes/No):	Yes	Quality of Supervision (QSA):	Moderately Unsatisfactory
DO rating before Closing/Inactive status:	Unsatisfactory		

<b>D. Sector and Theme Codes</b>		
	<b>Original</b>	<b>Actual</b>
<b>Sector Code (as % of total Bank financing)</b>		
Central government administration	6	4
Sanitation	14	12
Sewerage	20	
Water supply	60	84
<b>Theme Code (Primary/Secondary)</b>		
Land administration and management	Primary	Primary
Other urban development	Secondary	Secondary
Pollution management and environmental health	Primary	Primary
Rural services and infrastructure	Secondary	Secondary
Water resource management	Primary	Primary

<b>E. Bank Staff</b>		
<b>Positions</b>	<b>At ICR</b>	<b>At Approval</b>
Vice President:	James W. Adams	Jean-Michel Severino
Country Director:	David R. Dollar	Nicholas C. Hope
Sector Manager:	Magdolna Lovei	Joseph R. Goldberg
Project Team Leader:	Liping Jiang	Daniel J. Gunaratnam
ICR Team Leader:	Liping Jiang	
ICR Primary Author:	Xueming Liu	
	Ajay Markanday	
	Tao Gu	

## **F. Results Framework Analysis**

### **Project Development Objectives** (from Project Appraisal Document)

The project development objectives (PDOs) defined at appraisal were:

(a) Reducing the severe infrastructural bottlenecks in water supply that impede economic growth;

(b) Increasing employment and incomes by eliminating the paramount constraint to development;

(c) Reducing the distress of the urban population caused by insufficient and intermittent water supplies, which are barely enough to meet their basic needs;

(d) Improving the environment by ending the over-extraction of groundwater and the subsequent drying of surface streams and land subsidence, and by treating all waste, so as to reduce water pollution downstream;

(e) Creating a system to rationalize water use, by sector, and reducing water shortages by managing demand; and

(f) Promoting integrated management and financial independence for water institutions.

**Revised Project Development Objectives (as approved by original approving authority)**

No changes were made to the PDOs.

**(a) PDO Indicator(s)**

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Indicator 1 :</b>	Annual Water from the Yellow River shall be supplied to Taiyuan City			
Value quantitative or Qualitative)	zero	320 million cubic meters		75 million m <sup>3</sup>
Date achieved	01/31/1998	12/31/2005		12/31/2006
Comments (incl. % achievement)	The water demand projection was over-estimated in the Staff Appraisal Report (SAR), based on which works have been constructed. [See Section 3.2.2 ( 23.4 percent of original target.)]			
<b>Indicator 2 :</b>	Reducing overdraft of groundwater in Taiyuan			
Value quantitative or Qualitative)	644,000 m <sup>3</sup> /day	459,000 m <sup>3</sup> /day		563,500 m <sup>3</sup> /day
Date achieved	01/31/1998	12/31/2005		06/30/2007
Comments (incl. % achievement)	Accounting for 77 percent of the SAR target			
<b>Indicator 3 :</b>	Corporatization of major water institutions and formation of the Fen River Basin Commission to maximize the benefits of the project			
Value quantitative or Qualitative)	No changes in Institutional arrangement were made for unified water resources management	Corporatization of major water institutions and formation of the unified Fen River Basin Commission		Corporatization of major water institutions was not achieved by the Closing Date. The unified Fen River Basin Commission was established right before the Closing Date.

Date achieved	01/31/1998	12/31/2005		06/30/2007
Comments (incl. % achievement)	See ICR Main Text Section 3.2.2			
<b>Indicator 4 :</b>	Reducing distress to householders by lack of water supply			
Value quantitative or Qualitative)	45	88		140
Date achieved	01/31/1996	12/31/2005		12/31/2006
Comments (incl. % achievement)	The project achieved 159 percent of the SAR target			

**(b) Intermediate Outcome Indicator(s)**

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
<b>Indicator 1 :</b>	Yellow river water, local water and groundwater shall be utilized in an economic and optimal way, and groundwater table shall rise gradually due to closure of groundwater wells.			
Value (quantitative or Qualitative)	Serious overdraft of groundwater	Groundwater table in Taiyuan starts to rise		Groundwater table continues to rise in some local areas
Date achieved	01/31/1998	12/31/2005		06/30/2007
Comments (incl. % achievement)	See ICR Main Text Section 3.2.2			

**G. Ratings of Project Performance in ISRs**

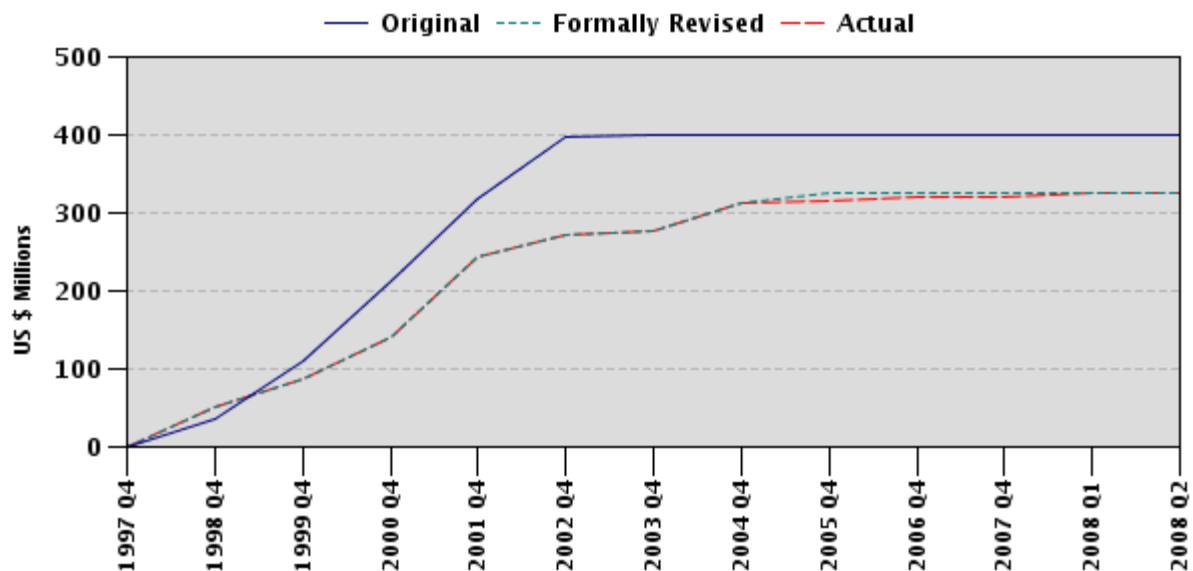
No.	Date ISR Archived	DO	IP	Actual Disbursements (USD millions)
1	12/22/1997	Highly Satisfactory	Satisfactory	9.00
2	12/13/1998	Satisfactory	Satisfactory	63.29
3	06/23/1999	Satisfactory	Satisfactory	86.80
4	06/28/1999	Satisfactory	Satisfactory	86.80
5	12/30/1999	Satisfactory	Satisfactory	106.57
6	12/30/1999	Satisfactory	Satisfactory	106.57
7	12/30/1999	Satisfactory	Satisfactory	106.57
8	06/28/2000	Satisfactory	Satisfactory	140.75
9	12/29/2000	Satisfactory	Satisfactory	188.97
10	06/26/2001	Satisfactory	Satisfactory	232.45
11	12/18/2001	Satisfactory	Satisfactory	264.49
12	06/28/2002	Satisfactory	Satisfactory	272.19

13	07/01/2002	Satisfactory	Satisfactory	272.19
14	12/20/2002	Satisfactory	Satisfactory	274.53
15	06/10/2003	Satisfactory	Satisfactory	275.55
16	12/16/2003	Satisfactory	Satisfactory	302.42
17	06/22/2004	Satisfactory	Satisfactory	311.93
18	12/10/2004	Satisfactory	Satisfactory	313.09
19	05/30/2005	Moderately Satisfactory	Unsatisfactory	314.43
20	12/30/2005	Unsatisfactory	Satisfactory	318.44
21	05/31/2006	Satisfactory	Satisfactory	320.59
22	01/26/2007	Unsatisfactory	Unsatisfactory	320.59
23	06/25/2007	Unsatisfactory	Unsatisfactory	320.59

## H. Restructuring (if any)

Not Applicable

## I. Disbursement Profile





## 1. Project Context, Development Objectives and Design

### 1.1 Context at Appraisal

**1.1.1 Country and Sector Background:** China's impressive economic performance since 1978 with a growth rate of GDP of 9.5 percent per year has been mainly in the industrial and commercial sectors and is concentrated in urban areas; as a result, urban water demand has increased by over 500 percent. Available water supplies, however, have met only 20 percent of the increase. By 1995, 400 of China's 514 largest cities suffered water shortages, with 100 of them, located in the North China Plain (NCP) being characterized as "desperately short" of water. The economic loss caused by these water shortages is estimated at US\$12 billion per year. Water shortages also affected domestic users, with household consumption in NCP cities averaging between 20 and 50 litres per capita per day (l/c/d) compared to a minimum requirement of 20 l/c/d. The shortages have also had adverse environment impacts as local surface water was completely exhausted and groundwater seriously over-drawn, leading to land subsidence in some cities and salt water intrusion in coastal areas. In Shanxi Province, the most important economic impacts of the water shortage were observed in the industrial cities of Taiyuan, Datong and Pingshuo where surface water supplies were virtually non-existent and ground-water has been over-extracted to a degree leading to land subsidence (of over three meters in many places). As a result, all sectors and population groups have suffered. The SAR contended that by the year 2000, water demand in these three areas would outstrip supplies by a factor of 70 percent, with the gap growing much wider afterwards.

**1.1.2 Rationale for Bank Assistance:** Consistent with the 1997 Country Assistance Strategy (CAS), the proposed project supported development efforts focused on: (a) China's poorer interior provinces; (b) alleviating infrastructural constraints to continued economic development; and (c) enterprise reform by commercializing operations and, *inter alia*, introducing rational pricing and fostering environmental protection for river basins. In this regard, the project was expected to ease infrastructural constraints in the water supply sector that are now impeding Shanxi's economic and industrial growth, with consequent effects on employment and poverty alleviation. It was also expected to relieve periodic municipal water shortages and to improve the environment by reducing dependency on groundwater resources and introducing modern water treatment facilities. By supporting the creation of water resource corporations at various levels and commercializing those operations by enabling them to trade water and set prices at commercial rates, the project was expected to support enterprise reform. In technology transfer, project tunnels (some of the longest in the world) would be constructed by double-shielded boring machines and the use of a master computer-controlled supervisory system would optimize pumping rates to save energy costs. Although the Bank has assisted in many water resource and irrigation projects in the Yellow River Basin, the most important lessons for this project were drawn from the Xiaolangdi Multipurpose Project, Shuikou and Ertan Hydroelectric Projects.

### 1.2 Original Project Development Objectives (PDO) and Key Indicators

**1.2.1** The project was seen as important for reducing infrastructure bottlenecks (caused by extreme water shortages), increasing employment and thereby reducing poverty, decreasing human distress caused by intermittent and limited water supplies, and improving river water quality. The stated project objectives were:

- a) Reducing the severe infrastructural bottlenecks in water supply that impede economic growth;
- b) Increasing employment and incomes by eliminating the paramount constraint to development;
- c) Reducing the distress of the urban population caused by insufficient and intermittent water supplies that are barely enough to meet their basic needs;
- d) Improving the environment by ending the over-extraction of groundwater and the subsequent drying up of surface streams and land subsidence, and by treating all waste to reduce water pollution downstream;

- e) Creating a system to rationalize water use, by sector, and reducing water shortages by managing demand; and
- f) Promoting integrated management and financial independence for water institutions.

1.2.2 The objectives were consistent with the brief description of the project objective in the Loan Agreement (Schedule 2), which states “*The objectives of the Project are to assist the Borrower in expanding the water supply in Taiyuan in a manner designed to ensure sustained economic growth in an environmentally sound manner and reduce poverty by increasing employment*”.

1.2.3 Key indicators monitored during implementation were:

Indicator 1: Annual water supply to Taiyuan City

Indicator 2: Reducing the overdraft of groundwater in Taiyuan

Indicator 3: Reducing household water use distress

Indicator 4: Corporatization of major water institutions and formation of the Fen River Basin Commission.

### 1.3 Revised PDO and Key Indicators, and Reasons/Justification

No revisions were made in PDOs or the key indicators.

### 1.4 Main Beneficiaries

1.4.1 The SAR identified the direct primary beneficiaries of the project as: (a) urban households, through increased water supply for domestic use; (b) workers in factories and mines, through economic growth and employment; and (c) farmers as indirect beneficiaries through the increased treated water supply for irrigation.

### 1.5 Original Components

1.5.1 The project as described in the SAR had three components.

**Component 1: Yellow River Diversion Project Corporation (YRDPC)** included: (a) the physical river diversion works (construction of tunnels and water delivery structures and equipment); (b) resettlement and compensation for households displaced by the construction of aqueducts; (c) environmental management; and (iv) consultant services.

**Component 2: Water Resources Institutional Reform** included the reform of all water resources institutions in the Yellow River delivery area through integrating principal institutions (such as the YRDPC, Fen-1 and Fen-2, Fenhe Irrigation Bureau and Taiyuan groundwater institutions) into an Upper Fen River Basin Commission (UFRBC) that would have the responsibility of licensing all ground and surface water extraction in the Upper Fen Basin, and corporatization of the major water institutions.

**Component 3: Water Pollution Control and Industrial Waste Water Management** included: (a) developing an environment master plan for Taiyuan; (b) training and upgrading the Environmental Protection Bureau (EPB); and (c) administering a fund for cleaner technologies in major polluting industries like steel and coke production.

1.5.2 The main causal links envisaged from various activities under project components were to provide the physical structures needed to transfer water from the Yellow River and support policy and institutional reform to improve economic water pricing and water marketing. The causal links between component outputs and PDO outcome are assessed in Section 2.3.

## 1.6 Revised Components

No changes were made in components during the implementation of the project.

## 1.7 Other Significant Changes

1.7.1 There were no significant changes in project design, scope, implementation arrangements or schedule except that a part of the savings made in the use of the Bank loan of US\$13.8 million was used to continue reducing the environment pollution in accordance with the same mechanisms and procedures set out during project appraisal for the B5 sub-loan sub-component of the project and a cancellation of US\$75 million from the Bank loan as the result of procurement issues. The cancellation was based on the request from MOF due to the disagreement between Shanxi Province and the World Bank on the issue of awarding the Lot IV contract for the connecting works. Afterwards, the province completed the connecting works successfully according to the original design with its internal funds.

## 2. Key Factors Affecting Implementation and Outcomes

### 2.1 Project Preparation, Design, and Quality at Entry

2.1.1 The Quality at Entry of the project is rated as having been “unsatisfactory” for a number of reasons.

2.1.2 Project design was based on the following background analysis: (a) a strong positive growth in overall water demand from water-intensive industries in and around Taiyuan City; (b) a dwindling supply from groundwater; (c) grave environmental (and associated economic) costs related to over-drafting groundwater, which in the “worst-case scenario” could have led to major soil subsidence in Taiyuan and the possible need to relocate the city and the industrial base; and (d) the need to ensure economic efficiency in overall water delivery, markets and pricing. Although the overall rationale was justified, there were significant weaknesses in the analysis of (a) and (d).

2.1.3 **Industrial Water Demand:** The underlying SAR assumption of growth in total water demand was grossly over-estimated. This was the result of:

(a) the high demand projections for water-intensive industries, which did not factor in the (very large) savings that have resulted from the adoption of more efficient water-saving technologies<sup>1</sup>; over the last decade there has been an inverse relationship between the growth in industrial output (GDP) and overall water demand<sup>2</sup> largely resulting from efficiency gains in water use and partly from the move toward a less water demanding service-based economy; and

(b) savings in water use due to more stringent environmental regulations and enforcement, which have resulted in the closure of a large number of small and inefficient water-using industries and/or their consolidation into larger and much more water efficient enterprises. The SAR projections for total industrial water demand compared to ICR estimates are shown in Table 1, which show large differences (actual industrial use in 2005 was less than the half the SAR projection for 2000).

**Table 1: Estimated Total Industrial Water Demand Taiyuan (in million m<sup>3</sup>)**

	2000	2005*	2010	2020
SAR	382.2	NA	565.9	728.1
ICR	-	177.8	278.8	467.7

<sup>1</sup> This was done despite the implicit awareness in the SAR of rapid improvements in the efficiency of water use (SAR, page 7, paragraph 2.8).

<sup>2</sup> The SAR claimed the original projections for growth in water demand by government agency were “conservative”.

Difference	-	-	287.1	260.5
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Source: SAR Table 7.1, Annex 7 and ICR mission/YRDPC estimates

\* Actual use based on Water Resources Department figures.

**2.1.4 Efficiency and Pricing:** Given the urgent need to avert a potentially disastrous situation, the fundamental objective of the project should have been to supply diverted water to Taiyuan City as rapidly as possible to substitute ground water use. Accordingly, diverted water from the Yellow River should initially have been priced lower than the prevailing price of groundwater as an entry point to facilitate this critical substitution, and the diversion system should have been operated as a government regulated water utility. Once this had occurred and the use of groundwater curtailed to safe and sustainable levels, prices could have been increased gradually to cover O&M costs<sup>3</sup>. Instead, the commercialization and full-cost pricing of the project design had exactly the opposite effect where significantly cheaper<sup>4</sup> ground-water continues to be over-exploited, effectively crowding out the demand for diverted water (Annex 3).

**2.1.5** Lessons learned in physical aspects were highly valuable in enabling rapid progress to be made in procurement, consulting, and construction on schedule to high quality standards. In marked contrast, however, there were both design and subsequent supervision weaknesses<sup>5</sup> on the Bank's part in ensuring that progress in "hard" infrastructure aspects remained well-synchronized with critical and equally important institutional and pricing reforms. At appraisal, more attention should have been given to lessons learned in other Bank projects in the water sector, particularly those involving institutional reforms, which would have highlighted the importance of longer-term engagement and commitment.

**2.1.6** The rationale for Bank intervention should have been based on a more programmatic and long-term approach with a matching loan instrument that would have better served the client and the Bank than the short-term, "projectized" approach that was adopted, given the extremely long-term vision of the government for the overall Wanjiazhai Water Transfer Programme and its "gradualist" approach to water sector reforms (Section 3.2.2).

**2.1.7** Three factors compromised project design: inadequate gauging of the political commitment of water administrative department of the government to institutional reform, the complexity of involving and restructuring multiple water agencies, and highly unrealistic assumptions on the time-frame required for completing key reforms by the end of the Bank project. This weakness resulted in virtually no progress being made in institutional reforms up to the original project completion date in 2003. Although overall project design was not unduly complex, the interfaces between components and their outputs (which was crucial for successful implementation) was very weak (Sections 1.5 & 2.3).

**2.1.8** In the SAR, physical, financial, implementation, institutional, environmental and economic risks were considered. However, with the benefit of hindsight the mitigation measures advocated, particularly with respect to institutional reform, were over-ambitious and turned out to be unworkable.

**2.1.9** The QAG rating for Quality at Entry was "satisfactory" (see Section 5.1).

<sup>3</sup> The emphasis in the SAR on full-cost pricing was unworkable not least because of the very significant investment costs of diverting water from more than 300 km away and factoring the depreciation of this enormous and inordinate cost into water prices. The continued practice of pricing on the basis of full cost recovery by the YRDPC, moreover, has led to a bizarre situation where the provincial government (having paid for the investment) also provides YRDPC a subsidy for depreciation.

<sup>4</sup> The current water resources fee (tax) on ground-water averages is less than 1 Yuan/m<sup>3</sup> depending on user, whilst the average price of diverted water is 2.5 Yuan/m<sup>3</sup>.

<sup>5</sup> This was notably true of bank supervisions in the early project years, which focused heavily on physical achievements, though later supervisions (post-2002) attempted to redress the failure in institutional reforms through four loan extensions and agreeing on time-bound plans of action.

## 2.2 Implementation

2.2.1 In infrastructure aspects, project implementation was highly successful and was completed to a high standard of quality and on schedule. However, implementation progress in institutional and pricing aspects was slow and problematic. An opportunity was missed early in implementation to synchronize institutional aspects with construction, whilst the failure to thoughtfully evaluate and revise water pricing principles (away from full cost to competitive prices) led to the serious problems outlined in Section 2.1. The repercussions of these shortcomings significantly compromised outcome.

2.2.2 Implementation efficiency was compromised by serious issues identified in Quality at Entry, in particular the failure to ensure that different “hard” and “soft” aspects of the project were coordinated and to implement changes in water tariff pricing when the expected uptake in demand for transferred water failed to materialize. In addition, in the first three years of project implementation, supervision missions did not sufficiently address institutional reforms whilst commitment on the Borrower’s side to follow mitigation measures (such as action plans etc) was weak. However, in the years after the physical works were completed, the Bank team with a new TTL has made great efforts to refocus on the reform agenda and tried to turn the situation around. The Bank has been flexible by extending the project four times in order to stay engaged in the dialogue with MOF, Ministry of Water Resources and the provincial government for policy impact. Despite the great difficulties due to inadequate political commitment to reform and little leverage the Bank had at the time, the Bank team continued to field supervision missions and to have dialogue with the various stakeholders for five years to persistently push forward the institutional and pricing reform. Due to the joint efforts from MOF, provincial government and the Bank, finally it was encouraging to see that provincial government took some positive measures on institutional and pricing reform shortly before and after the project closure, the river basin authority was established and the regulation for integrated water and environment protection in the basin was cleared by the provincial government right before the project closure and approved by the Provincial People's Congress shortly after the project closure, which was a good start to go towards the ultimate goal of the integrated water and environment management in the basin.

2.2.3 The QAG rating for supervision was “moderately unsatisfactory” (see Section 5.1).

## 2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization

2.3.1 **M&E design and implementation were weak:** Apart from the indicators for PDO (c) and (d), the M&E design and structure cannot be effectively used in assessing project impact and outcome (Section 3.2.2). Importantly, no physical targets/year for the volume of water transferred from the Yellow River was outlined in the SAR, with the only indications coming from assumptions in the economic analysis that which grossly over-estimated demand. These demand assumptions, moreover, formed the basis for monitoring in the ISRs. For individual PDOs, the M&E design was inadequate in the following aspects:

- a) PDO 1: the indicator should have captured incremental water supply directly attributed to the project. The efficiency measure (of value-added per m<sup>3</sup> of water delivered) was clearly outside the projects control;
- b) The same rationale applies to PDO 2, where any impact on employment and incomes cannot realistically be attributed to the project alone, especially given the very rapid economic growth in China and the upward movement in high tech (service) industries which are not water-use intensive;
- c) Indicators for PDOs 3 and 4 were acceptable and relevant;
- d) PDO 5 is vague and ambiguous, which precludes any meaningful assessment; and

- e) Although it is recognized that indicators for PDO 6 were difficult to define, some milestones in the complicated process of institutional reform should have been included that could have formed the basis of discussion on progress during supervision.

#### 2.3.2 M&E utilization was inadequate because of:

- a) The inadequacy of M&E design of indicators for PDO 1 and 2;
- b) Indicators for PDO 3, 4 and 5 were not effectively used in decision-making as it was known early in project implementation that delivery targets were unlikely to be met; and
- c) There were no useful milestones outlined for PDO 6. Had they been included they could have been extremely useful as benchmarks for progress on institutional issues.

### 2.4 Safeguard and Fiduciary Compliance

2.4.1 The project triggered OP4.01 Environment Assessment and OP4.12 Involuntary Resettlement, which were duly complied with in line with Bank procedural requirements. The fiduciary aspects of project implementation were in accordance with the Bank's Financial Management (OP10.02), Procurement (OP11.00) and Disbursement (OP12.00) policies.

### 2.5 Post-completion Operation/Next Phase

2.5.1 The project was part of a large and continuing national water sector development program in Shanxi Province (Section 3.2.2) for which full development will require at least another ten years. The Bank was a relatively small co-financier (30 percent of Phase 2 costs) of the program, financed by the provincial budget. There is therefore no issue of "transition to regular operation" *per se*. Even under Phase 2, for example, a number of works are still in progress (e.g., the construction of the regulation reservoir for the south line).

2.5.2 Furthermore after closure of the Bank-assisted project, the Provincial Government implemented a number of critical measures (under the August 3, 2007 Provincial Governor's Decree No. 108). These included time-bound targets (over the next two years) for closure of remaining ground-water wells and increasing water resources fees for ground-water from October 2007. In addition, legislation to establish the Upper Fen River Basin Commission and the law on Upper Fen River Water Conservation and Environmental Protection were reviewed by the Provincial Peoples' Congress on September 24, 2007.

## 3. Assessment of Outcomes

### 3.1 Relevance of Objectives, Design and Implementation

3.1.1 The fundamental objectives of the wider WWTP program of: (a) reducing environmental and associated economic risks of over-extraction of ground-water through its substitution with transferred water; and (b) alleviating structural bottlenecks in water supply in provincial economic growth remain consistent with the emphasis of sustainable economic growth with sound environment and natural resource management in the current CAS, in particular under the third thematic pillar of facilitating environmentally-sustainable development<sup>6</sup>. The objectives also remain highly relevant to government priorities related to developing the water sector, general economic growth and sustainable development.

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<sup>6</sup> These are reflected in the third thematic pillar in the CAS that aims to facilitate environmentally-sustainable development through: (a) strengthening the effectiveness of environmental institutions; (b) improving air quality; (c) managing water resources; (d) managing land and natural resources; and (e) protecting global environmental commons.

3.1.2 As emphasised in various sections of the ICR, it is important to view Bank assistance in the context of the government's continuing longer-term national water sector development program. To address the over-designed capacity of the south line, the government has initiated a number of remedial measures to expand water transfer coverage to enhance development impact (Section 2.5.2).

## 3.2 Achievement of Project Development Objectives

3.2.1 Whilst it is recognized that at appraisal the requirements for the design of the PDO and M&E indicators were significantly different from current (results-based) requirements, there were severe weaknesses in the specification of the PDOs and associated performance indicators that make an *ex post* evaluation (based on these) incomplete (Section 2.3).

**PDO 1:** "Reducing the severe infrastructural bottlenecks in water supply that impede economic growth" for which the indicators are outlined in Table 1, Annex 12 of SAR. The design of indicators for PDO 1 was flawed. The indicators erroneously assumed a strong (almost linear) positive correlation between water use and growth in the value of industrial output by sector. This causal relationship has been proven to be wrong as it failed to take into account the dynamic changes in the adoption of new technologies, large increases in industry's efficiency of water use (in terms of value of GDP per m<sup>3</sup>) and stringent enforcement of environmental laws resulting in the closure of a large number of small water-intensive township and village enterprises (TVEs). In fact, official statistics show that whilst industrial output increased by 77 percent between 1993 and 2002, the total annual water consumption declined by 40 percent (Table 2).

**Table 2. Industrial Value Growth and Water Consumption by Sector**

Industry	Item	Unit	1993	2002	Annual Rate of Change (%)
Iron/steel	GDP	RMB million	4,524.34	11,964.06	9.2
	Water consumption	million m <sup>3</sup>	53.82	45.23	-1.6
	Water consumption/GDP	m <sup>3</sup> /RMB million	1.19	0.38	-9.9
Electricity	GDP	RMB million	506.28	1,252.98	8.6
	Water consumption	million m <sup>3</sup>	44.52	53.63	1.7
	Water consumption/GDP	m <sup>3</sup> /RMB million	8.79	4.28	-6.3
Coal	GDP	RMB million	1,887.84	946.73	-6.1
	Water consumption	million m <sup>3</sup>	24.24	7.37	-10.3
	Water consumption/GDP	m <sup>3</sup> /RMB million	1.28	0.78	-4.4
Chemical	GDP	RMB million	2,329.08	11,930.29	16
	Water consumption	million m <sup>3</sup>	43.88	36.72	-1.6
	Water consumption/GDP	m <sup>3</sup> /RMB million	1.88	0.31	-15.2
Other	GDP	RMB million	7,183.77	11,930.29	5.8
	Water consumption	million m <sup>3</sup>	65.48	36.72	-6.2
	Water consumption/GDP	m <sup>3</sup> /RMB million	0.91	0.31	-11.4
Total	GDP	RMB million	17,223.08	30,575.66	6.6
	Water consumption	million m <sup>3</sup>	273.53	164.18	-5.5
	Water consumption/GDP	m <sup>3</sup> /RMB million	1.59	0.54	-11.4

Source: Shanxi Provincial Statistics Bureau.

**PDO 2:** "Increasing employment and incomes by eliminating the paramount constraint to development" (SAR, Table 1, Annex 12). PDO 2 is poorly defined and excessively broad. Although the project may well have contributed to an increase in employment and incomes, the overall growth

in these cannot realistically be attributed to the project alone, especially given very rapid economic growth in China and the upward movement in high technology (service) industries which are not labour and water intensive.

**PDO 3:** “Reducing the distress of the urban population caused by insufficient and intermittent water supplies, which are barely enough to meet their basic needs” (SAR, Table 1, Annex 12). PDO 3 was better defined and measurable. Actual water consumption per household per day (140 l/c/d in 2005) was significantly (60 percent) higher than the SAR target of 88 l/c/d. This has substantially reduced the distress of insufficient water supplies and improved access to water.

**PDO 4:** “Improving the environment by ending the over extraction of groundwater and the subsequent drying of surface streams and land subsidence, and by treating all waste, so as to reduce water pollution downstream” (SAR, Table 1, Annex 12). In relation to PDO 4 the project has had noticeable impact in reducing the over-extraction of ground water, though not to the level envisaged at appraisal. Compared to the total target value of 459,000 m<sup>3</sup>/day (2005) for total extraction, the level achieved was 563,500 m<sup>3</sup>/day. This indicates some 104,500 m<sup>3</sup>/day were extracted more than the target, or conversely the project only achieved 77 percent of the SAR target for total extraction. Based on surveys by the Water Resources Department, in severely over-drafted areas the water-table has risen by between 7 and 15 meters as a result of the reduction in ground-water over-drafting. However, the city will still need to use more the Yellow River water to further reduce the extraction to reach the sustainable use of groundwater. It is difficult to make judgments on the improvements in water quality as no systematic monitoring has been undertaken.

Both PDO 5 and PDO 6 were intended to introduce key institutional and pricing reforms in the water sector. PDO 5 was partially achieved as the unified Fen River Basin Commission was established immediately before the Loan’s Closing Date, while the corporatization (commercialization) of water institutions (PDO 6) had not been accomplished per the design and time-frame set out in the SAR.

3.2.2 Given the limitations of PDO indicator design and bearing in mind that the WWTP is only a slice of a much larger and continuing government program, the evaluation by component is further conducted below:

**Component 1: Physical Structures** under the project were completed on time, to a high standard and to design capacity. These included: (a) construction of the General Main Tunnel (GMT) and South Main Tunnel (SMT) to Taiyuan; (b) five pumping stations; (c) seven tunnels and aqueducts; and (d) bifurcation structures for the SMT. There was a cancellation of US\$75 million from the Bank loan as the result of procurement issues (Section 1.7.1). The standards and quality of construction for physical structures have been reviewed by the MWR and were found to be either satisfactory or highly satisfactory (Annex 1, Table 1). However, by the time of the ICR mission some supplementary works solely financed by the government were still in progress (e.g., the regulation reservoir at the Huyan water treatment plant).

**Component 2: Water Resources Institutional Reform.** Progress in key institutional reforms was difficult and slow, and corporatization of major water institutions was not achieved, which has adversely affected the benefit of the project. A number of critical measures were taken just before or after project closure (on June 30, 2007) related to further reduction of ground-water extraction and to institutional and pricing reforms. These have been sanctioned through the Provincial Governor’s Decree No 108 (issued on August 3, 2007) that sets out time-bound targets (over the next two years) to close down remaining ground-water wells and raise water resources fees for ground-water from October 2007. In addition, legislation to establish the Upper Fen River Basin Commission and the law on Upper Fen River Water Conservation and Environmental Protection were reviewed and approved by the Provincial Peoples’ Congress on 24 September 2007. Although it’s still a long way to go to reach the goal of the integrated river basin water and environment management, these are seen as extremely important steps in meeting the development objectives of the program which with hindsight



should have been included as key milestones in project design to make it happen much earlier. Given that these key measures will require at least two years for implementation, it is premature to prejudge the effect they will have on the outcome of the overall national program.

**Component 3: Water Pollution Control and Industrial Waste Management.** The project achieved the following: (a) the preparation of an environmental master plan (2000); (b) an up-grading of skills in pollution control in the EPB and the establishment of a monitoring system for water and wastewater quality; and (c) under an US\$8 million revolving fund for the introduction of cleaner technologies, 13 industries received loans amounting to US\$8.12 million. By the end of the project, US\$7.99 million had been reimbursed. Based on the success of the sub-loans under the project, a second revolving fund (from project savings) was established after the Bank-supported project closed.

### **3.3 Efficiency**

3.3.1 At appraisal, the major project benefits were to be derived from: (a) reducing the severe water distress for domestic consumers in Taiyuan; (b) arresting the grave environmental (and associated economic) costs related to over-drafting groundwater, which in the worst-case scenario could have led to major subsidence in Taiyuan and the possible need to relocate the city and its industrial base; and (c) meeting the growing water demand expected for economic growth. The SAR estimated an economic internal rate of return (EIRR) of 22 percent with increased urban consumption generating 7 percent of the benefits, industrial consumption 85 percent and irrigation 10 percent.

3.3.2 The economic rate of return for the investment was recalculated following the original SAR approach and parameters (See Annex 7 SAR), using actual project costs, current prices and the volume of water delivered. The analysis shows that the project is not economically viable (ERR 0.85% and a negative NPV at an OCC of 12%), which is due to high project costs in relation to severe under-utilization of designed capacity (some 23%).

3.3.3 The methodology and approach used in the economic analysis at appraisal were not entirely appropriate and contributed to the over-dimensioned capacity, as outlined in Annex 3. Therefore, the estimates should be treated with caution. The Government is taking various measures to expand the coverage of diverted water to improve efficiency of the ongoing national programme. (See Section 3.5.3)

3.3.4 **Financial Analysis.** The YRDPC should not have been treated as a conventional revenue generating and profit making entity. In fact, over the last ten years the YRDPC has existed only in name and is fully financed by the government as a public institution at the same administrative level as the Water Resources Bureau. As such, financial analysis at both project and entity level is not applicable (see Annex 3)

### **3.4 Justification of Overall Outcome Rating**

3.4.1 The overall outcome is rated as having been “moderately unsatisfactory” based on the following assessment. In terms of the achievement of the PDOs, the project:

- a) was highly successful in increasing the supply of water for domestic use (PDO 3), which reached over 159 percent of the SAR target;
- b) was moderately successful in reducing the over-drafting of ground water (PDO 4) where 77 percent of the SAR target was met;
- c) can not be credited for attaining PDO 1, as no causal relationship can be established between incremental water supply from the project and economic growth (see section 3.2.1 PDO 1);
- d) can not be credited for attaining PDO 2, as it is poorly defined and excessively broad (see section 3.2.1 PDO 2)

- e) partially achieved PDO 5 as the unified Fen River Basin Commission was established right before the Loan's Closing Date (but not fully operational yet); and
- f) failed to achieve the corporatization (commercialization) of water institutions (PDO 6).

#### 3.4.2 In terms of the relevance of the objectives and the design:

- a) The project remains consistent with current Bank assistance strategy and government priorities for development of the water sector; and
- b) The over-dimensioned capacity of the project is being addressed by the government as part of its continuing national programme.

3.4.3 In terms of efficiency, the project is not economically viable given over-designed capacity and low utilisation. However, in recognition of this the Government is exploring various options for expanding coverage of diverted water to improve efficiency of the investment in the context of an ongoing national programme. (See Section 3.5.3)

3.4.4 Based on the Bank's relatively small (time and investment) slice, the ICR team recognizes that it is inappropriate to extrapolate the rating for the Bank-assisted project to the much larger and continuing government program, especially as various remedial measures<sup>7</sup> (below) are being put in place by the provincial government (after the closure of the project). These are likely to improve the outcome of the program significantly, and include:

- a) The Regulations on Water Resources Management and Environment Protection in Mid and Upper Fen River Basin (March 2007)<sup>8</sup>;
- b) Key price reforms, discontinuing full cost pricing in water tariffs;
- c) Expansion of the transferred water delivery to cover peri-urban areas in greater Taiyuan and other urban / industrial centres along the line; and
- d) A detailed plan for closure of ground-water wells.

### 3.5 Overarching Themes, Other Outcomes and Impacts

#### (a) Poverty Impacts, Gender Aspects, and Social Development

3.5.1 The project was not specifically a poverty reduction project. However, there were positive impacts on poverty through increased supply and accessibility of water for domestic use that directly benefited the poorer urban households.

#### (b) Institutional Change/Strengthening (particularly with reference to impacts on longer-term capacity and institutional development)

3.5.2 Institutional aspects of the project are assessed in Sections 2.1 and 2.5 and there are no additional aspects to be included in this section.

#### (c) Other Unintended Outcomes and Impacts (positive and negative):

3.5.3 As a result of the over-dimensioned design of the scheme (Section 2.1 and Annex 3), the government has recently decided to expand the delivery of transferred water to new areas not

<sup>7</sup> Measures are outlined in the Provincial Governor's Decree (108), issued on August 4, 2007.

<sup>8</sup> The regulation includes 29 clauses on various aspects including responsibility, planning and compensation etc.

previously covered (e.g., surrounding peri-urban areas around Taiyuan and other industrial and urban centres in central Shanxi along the line).

### **3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops**

3.6.1 No beneficiary survey made and no stakeholder workshop was held.

## **4. Assessment of Risk to Development Outcome**

4.1 At the time of the ICR evaluation, the project is considered to have negligible risks associated with technical, environmental and social aspects.

4.2 The major risks to the attainment of development outcome are related to financial, economic and institutional aspects, which became evident in the later stages of project implementation, particularly after the completion of civil works. These risks still remain highly relevant and include: (a) the incentive pricing of transferred water to replace ground water over-drafting; (b) strict enforcement of ceilings and limits to underground water mining; and (c) the urgent need to complete institutional reforms, especially a functioning Upper Fen River Basin Commission to license the allocation and sale of water from all sources. In addition, the government has recognised that to achieve greater development and cost-effectiveness (given the over-capacity and very large investment incurred), it is imperative that the coverage of transferred water be expanded to other parts of central Shanxi (Section 3.4.2).

4.3 Based on implementation experience the Borrower has gradually internalized key risks and adopted mitigation measures. The culmination of these measures came in August 2007 (after project closure) through the Provincial Governor's Decree No 108 which sets out time bound targets to specifically address the factors above. This represents strong commitment at the highest political level in the province and is supported by the laws and regulations (Section 3.4).

4.4 Taking into account the above, the overall risk to the development outcome is rated as moderate.

## **5. Assessment of Bank and Borrower Performance**

### **5.1 Bank Performance**

#### **(a) Bank Performance in Ensuring Quality at Entry**

5.1.1 Bank performance in ensuring Quality at Entry is rated as having been "unsatisfactory" (Section 2.1), compared to a QAG review that rated it as "satisfactory". The QAG rating cannot be further discussed as detailed comments supporting the rating were not made available to the ICR team, despite several requests.

#### **(b) Quality of Supervision**

5.1.2 Overall, the quality of supervision is rated as "moderately satisfactory".

5.1.3 In the early years of project implementation, supervision was heavily focused on delivery and monitoring of physical aspects of the project, with inadequate attention being given to ensuring that the project moved forward commensurately with key institutional and pricing reforms. This, coupled with initial design weaknesses in quality at entry (unrealistic timeframe for reform and not incorporating triggers and milestones for the process itself), resulted in de-linking the "hard" and "soft" parts of the project; highly satisfactory delivery in infrastructure but unsatisfactory performance in institutional reforms. This was not fully internalized by the task team until 2002 (when physical works had largely been completed), after which the team made significant efforts to push the reform

agenda, albeit with little leverage. The decision to extend the project's life and provide supervision support was instrumental in keeping institutional reforms in the water sector high on the government's agenda and culminated in the Governor's policy Decree 108 and related legislation that will have significant impact on long-term development effectiveness of the overall national programme.

5.1.4 In October 2006, the QAG rated the overall quality of supervision as "moderately unsatisfactory". The Region considered that project supervision should have been rated "moderately satisfactory" for the following reasons: (a) slow progress in institutional reforms was mainly the result of weakness in project design (Section 2.1) coupled with a lack of political commitment by government to the reforms in the initial stages of the project; (b) during the project extension, supervision missions made significant efforts to push forward the reform agenda which resulted in a series of positive measures taken by the government just before or after project closure (paragraphs 2.2.2 and 2.5.2). The Bank agreed to extend the project by five and half years to engage the Borrower in initiating a complicated reform process. The active engagement of the Bank in the latter part of the project facilitated the formation of the Upper Fen River Basin Corporation (UFRBC) and the passing of the Provincial Government Decree 108 on August 3, 2008, which will pave the way for future utilization of the currently-unused carrying capacity of the water delivery system created through the project. The quality of supervision over the entire project implementation period is rated as "moderately satisfactory".

#### **(c) Justification of Rating for Overall Bank Performance**

5.1.5 Overall, the Bank's performance is rated as "moderately unsatisfactory" based on the assessment ratings for quality at entry and supervision outlined above.

### **5.2 Borrower Performance**

#### **(a) Government Performance**

5.2.1 Within the context of a long-term national program, the Government performance is rated as "moderately satisfactory".

5.2.2 As indicated above (Section 3.4), the government has had a long established commitment to the National Programme for Water Transfer (NPWT), dating back to the 1960s. The Bank only became involved in the second phase of the national programme in the mid 1990s as a relatively small co-financier.

5.2.3 Under the project, the government viewed the Bank as a strategic partner that would bring wide international expertise and know-how into its large and complex water diversion program. In technical aspects there was strong commitment and "buy-in" from the government in relation to design and international best practices in engineering works. Even though the government was also committed to institutional and pricing reform (on which they followed the Bank's advice), there was much less appreciation of their complexity and magnitude. This shortcoming was compounded further by: (a) the absence of a conducive national water sector policy framework on the optimum utilization of surface and ground-water, water resources fees and taxes; and (b) the emphasis on full commercialization (in the Bank's business and water-pricing models) which were poorly conceived and unworkable.

5.2.4 The government, however, remains highly committed to the long-term objectives of the NPWT, is following a constructive "learning-by-doing" approach with regard to institutional reforms, and has put in place key policy measures and legislation to ensure long-term development effectiveness (Sections 3.4.2 and 4).

#### **(b) Implementing Agency or Agencies Performance**

5.2.5 The implementing agency performance is rated as “moderately satisfactory”. The main works and supplementary works have been completed in time with good quality so that it was highly successful in increasing the supply of water for domestic use (PDO 3), which reached over 159 percent of the SAR target, and was moderately successful in reducing the over-drafting of ground water (PDO 4) where 77 percent of the SAR target was met. The implementing agency tried its best in pushing forward the institutional reform, although this task was not in its mandates.

**(c) Justification of Rating for Overall Borrower Performance**

5.2.6. The overall Borrower Performance is rated as “moderately satisfactory” based on the above (a) and (b).

**6. Lessons Learned (both project-specific and of wide general application)**

**6.1.1 The project design should have considered how to achieve the project development objectives in the most effective way based on realistic water demand projection.** More careful justification of the investment size should have been undertaken taking into account the water savings from new technologies and more stringent environmental regulations, and possible policy interventions to prevent the serious over-design in capacity from happening.

**6.1.2 It is important to ensure that the “hard” infrastructure aspects remain coordinated and synchronized with the equally important “soft” aspects of institutional and pricing reform.** This should have been addressed right from the beginning of the implementation to achieve maximized project benefits and long-term impact. An opportunity was missed in the early years, which has led to de-linking of the two aspects and less than satisfactory outcome in institutional reform.

**6.1.3 To improve the effectiveness and sustainability of public service delivery, it is clearly desirable to incorporate elements of cost recovery in the pricing of the utility, though this should be phased in gradually.** Under the project, diverted water from the Yellow River should initially have been priced lower than the prevailing price of ground-water as an entry point to facilitate this substitution. Once this had occurred and the use of ground-water had been curtailed to safe and sustainable levels, prices could then have been increased gradually to cover O&M and (possibly) to recover some of the investment cost.

**6.1.4 The Bank’s involvement in institutional reforms in the water sector needs to be thoughtfully considered, well paced and supported by appropriate loan instrument.** This should have been based on a more programmatic and long term approach rather than short-term projectized approach. It requires sustained long-term engagement with government (particularly given China’s gradualist approach to reforms), an appropriate loan instrument (e.g., APL or SAL), and well-defined linkages to sector work and up-stream policy dialogue.

**6.1.5 In the institutional set up the Provincial Water Resources Bureau (instead of the Wanjiazhai Yellow River Diversion Project Corporation) should have been put in charge of the institutional reforms** as per its mandate stipulated in the National Water Law with strong support and coordination from the Provincial. It is legally responsible and best positioned to lead the proposed institutional, policy and pricing reform, which deals with large scale water resources administration, allocation and strategy issues in the province.

**6.1.6 Project Development Objectives and related M&E indicators need to be well defined.** Under the project, there were too many PDOs, some of which were overly broad and ambiguous, whilst a number of the indicators had no causal effect with project impact or had not target value. This impeded both project supervision and impact evaluation.

## Annex 1. Project Costs and Financing

### Project Cost by Component

Components	Appraisal Estimate	Actual /Latest Estimate	Percentage of Appraisal
	(US\$ million)	(US\$ million)	
<b>A. Water Transfer</b>	963.6	994.23	103.2
1. General Main	256.5	409.48	159.8
2. South main	296.5	343.94	116.0
3. Automatic Control System	30.1	29.88	99.3
4. Power Transmission Line	16.3	43.63	267.7
5. Administration/Management	132.4	36.42	27.5
6. Connection Works	231.8	130.87	56.5
<b>B. Institutional Component</b>	7.7	1.84	23.9
<b>C. Environmental Management</b>	10.6	24.4	230.2
1. Project B1	2.6	1.4	53.8
2. Project B2	8.0	23.0	287.5
<b>Total Baseline Cost</b>	981.9	1020.86	104.0
Physical Contingencies	136.5	-	-
Price Contingencies	169.3	-	-
<b>Total Project Costs</b>	1287.8	-	-
Interest During Construction	56.4	42.84	76.0
Commitment Charges	7.4	8.81	119.1
<b>Total Costs to be Financed</b>	1351.6	1072.10	79.4

### Financing

Source of Funds	Appraisal	Actual/Latest	Percentage of Appraisal
	Estimate (US\$ million)	Estimate (US\$ million)	
Government	921.6	747.5	81
IBRD/IDA	400.0	324.6	82
Loan of Italian Government	30.0	-	-
<b>Total Funds</b>	1351.6	1072.1	79

## Annex 2. Outputs by Component

Indicator	Unit	Original Target Values	Actual Achieved at Competition Values	Percentage of PAD
		(PAD)	(ICR)	
<b>Output Indicators</b>				
<b>A. General Main Tunnels</b>				
<b>1. Pressure Tunnels</b>	Km	<b>3.19</b>	3.075	96.4
Tunnel 1	Km	0.14	0.196	140.0
Tunnel 2	Km	0.13	0.214	164.6
Tunnel 3	Km	0.76	0.812	106.8
Tunnel 4	Km	1.72	1.699	98.8
Tunnel 5	Km	0.44	0.154	35.0
<b>2. Free Flowing Tunnels</b>	Km	<b>42.26</b>	<b>38.983</b>	<b>92.2</b>
Tunnel 6	Km	6.61	6.526	98.7
Tunnel 7	Km	2.67	2.685	100.6
Tunnel 8	Km	12.19	12.142	99.6
Tunnel 9	Km	0.21	0.217	103.3
Tunnel 10	Km	7.38	7.379	100.0
Tunnel 11	Km	10.01	10.034	100.2
<b>Pumping Station/PS</b>	No.	<b>3</b>	<b>3</b>	<b>100.0</b>
PS (between tunnels 3 & 4)	m <sup>3</sup>	81900	268117	327.4
PS (between tunnels 4 & 5)	m <sup>3</sup>	81900	305252	372.7
PS (between tunnels 10 & 11)	m <sup>3</sup> /s	48.0	48	100.0
<b>Regulation Reservoir</b>	m <sup>3</sup>	<b>150'000</b>	<b>202'400</b>	<b>134.9</b>
<b>Aqueducts</b>	No.	<b>4</b>	<b>4</b>	<b>100.0</b>
<b>B. South Main Tunnels</b>				
<b>1. Free Flowing Tunnels</b>	Km	<b>106.55</b>	<b>97.429</b>	<b>91.4</b>
Tunnel 1	Km	0.84	0.866	103.1
Tunnel 2	Km	1.87	1.892	101.2
Tunnel 3	Km	4.16	4.185	100.6
Tunnel 4	Km	6.93	6.882	99.3
Tunnel 5	Km	26.48	26.425	99.8
Tunnel 6	Km	14.63	14.583	99.7
Tunnel 7	Km	42.64	42.569	99.8
<b>Aqueducts</b>	No.	<b>3</b>	<b>3</b>	<b>100.0</b>
<b>Inverted siphon</b>	No.	<b>1</b>	<b>1</b>	<b>100.0</b>
<b>Culverts</b>	No.	<b>2</b>	<b>2</b>	<b>100.0</b>
<b>Pumping Stations</b>	No.	<b>3</b>	<b>2</b>	<b>66.7</b>
<b>C. Connection Works</b>				
<b>1. Pipeline</b>	Km	<b>40.209</b>	<b>42.79</b>	<b>106.4</b>

Indicator	Unit	Original Target Values	Actual Achieved at Competition Values	Percentage of PAD
		(PAD)	(ICR)	
<b>2. Tunnels</b>	Km	16.751	21.49	128.3
Tunnel 1	Km	0.447	3.486	779.9
Tunnel 2	Km	1.000	0.958	95.8
Tunnel 3	Km	0.562	0.172	30.6
Tunnel 4	Km	0.725	0.094	13.0
Tunnel 5	Km	0.795	2.470	310.7
Tunnel 6	Km	0.100	0.790	790.0
Tunnel 7	Km	13.122	13.520	103.0
<b>D. Control System</b>				
Central dispatching and control station	No.	1	1	100.0
Levels of control system	No.	3	3	100.0
<b>E. Plant and Equipment</b>				
<b>1. Pump</b>	unit	15	15	100.0
Pump power/GMT3&SMT12	MW	10.8	12	111.1
Unit capacity	m <sup>3</sup> /s	6.45	6.45	100.0
Static lift capacity	M	142	140	98.6
Pump power/Third level	MW	6.3	6.3	100.0
Unit capacity/Third level	m <sup>3</sup> /s	6.45	6.45	100.0
Static lift capacity/Third level	M	80	76	95.0
<b>2. Synchronous Motors</b>	unit	15	15	100.0
Capacity 6.75MW	No.	3	3	100.0
Capacity 12.5MW	No.	12	12	100.0

\* 1.The PAD target is cited from the SAR.



## **Annex 3. Economic and Financial Analysis**

### **Introduction**

1. Shanxi Province is located in north eastern China, bounded by the Yellow River to the west and south. The province has the least water resources *per capita* in the Yellow River Basin, and is the second driest province in terms of surface water resources. These are widely scattered among 15 river basins, which are separated by mountains, making inter basin transfers difficult and expensive. River flows exhibit a high degree of annual variation, although they are concentrated in the summer. In most areas, ground-water has been tapped to its limits with serious ecological consequences. In the province, the most important economic impacts of water shortage are in the northern urban industrial cities of Taiyuan (the capital and largest city), Datong (the second-largest city and mining centre) and Pingshuo (a rapidly-growing mining/industrial region). At appraisal, in Taiyuan and Datong surface water supplies had virtually dried up and ground-water had been over-extracted to a degree leading to land subsidence of over 3 metres (m) in many places. As a result, all sectors and population groups were suffering. The SAR anticipated that, by 2000, water demand in these three areas would outstrip supplies by a factor of 70 percent, with the gap growing much wider afterwards.

2. It was envisaged that the overall National Program would help alleviate water shortages through the construction of a water transmission line from the Yellow River at Wanjiashai Dam to Taiyuan, and later to Datong and Pingshuo. Given the large scope and significant cost of the water diversion scheme, the provincial government phased the programme into: (a) the construction of the dam at Wanjiashai; (b) the construction of the general main tunnel (GMT) and south main tunnel (SMT) to Taiyuan; and (c) construction of the north transmission lines to Datong and Pingshuo.

3. The Bank was a relatively small partner under Phase 2 above (around 30 percent of total Phase 2 cost of 8.7 billion Yuan). The main focus area for the project was Taiyuan City, which is located in north-central Shanxi along the Fen River and near abundant raw materials and energy sources. The city boasts one of the largest concentrations of heavy industry in China. *Per capita* water resources were only 51 percent of the provincial and 9 percent of the national average. As a result of water shortages 50 percent of mines, factories and enterprises periodically remained closed in Taiyuan. The rationale for the project, presented in the SAR, centred around the impact that large shortages of water would have on key industrial sectors in and around Taiyuan (such as coal and electricity) and ecological degradation. It was envisaged that the project would deliver up to 320 million m<sup>3</sup> per year in 2002, 900 million m<sup>3</sup> by 2010 and 1.2 billion m<sup>3</sup> by 2020. These volumes were considered within the allocations permitted by the Yellow River allocation designated by the State Council (Chinese Cabinet).

### **Project Benefits**

4. The major project benefits were derived from: (a) reducing the severe water distress for domestic consumers in Taiyuan; (b) arresting the grave environmental (and associated economic costs) related to over-drafting ground-water, which in the “worst-case scenario” could have led to major subsidence in Taiyuan and the possible need to relocate the city and its industrial base; and (c) meeting the growing water demand for economic growth.

### **Methodology and Approach Used in Economic Analysis**

5. Based on the benefit streams outlined above, the SAR used the following methods in economic analysis: (a) the willingness to pay (WTP) and consumer surplus (CS) approach in deriving the economic (shadow) price of domestic water use; and (b) input/output models and linear programming to determine the economic value of water for industrial use. The SAR did not take into

account ecological and environmental externalities in economic analysis. Nevertheless, the economic rate of return for the investment was recalculated following the original SAR approach and parameters (See Annex 7 SAR), using actual project costs, current prices and the volume of water delivered. The analysis shows that the project is not economically viable (ERR 0.85% and a negative NPV at an OCC of 12%), which is due to high project costs in relation to severe under-utilization of designed capacity (some 23%). (Excel models attached)

6. There were significant limitations in the SAR methodologies used and in the overall approach to economic and financial analysis as outlined below:

## Economic Analysis

### Economic Valuation of Industrial Water Use Based on Input/Output Models and Linear Programming

7. The economic analysis of water for industrial use was based on the calculation of the marginal value of water (MVW) by sector. After extensive discussion on the I/O model, the SAR concluded that the input/output model could not determine the MVW and therefore adopted a linear programming (LP) approach. The implicit assumption in using the LP model to generate the marginal values of water was that water was the only constraint and, if available, then output could increase and generate the values in the model. In other words, there are no other constraints such as labor or industrial capacity which could prevent these results from occurring.

8. This methodology would have been applicable had the principle of *ceteris paribus* held. In reality, the rapid adoption of new technologies and innovations quickly overtook the premise that water is the controlling factor. Data shows that whilst industrial output value increased by over 75 percent from 1993-2002, total water use declined by 40 percent as a result of the adoption of water saving technologies and innovations and the strengthening of environmental controls on water wasting industries (Table 1). The highly over-estimated demand projection based on unrealistic assumptions for industrial water use has led to the grossly over-designed capacity, which is the most serious problem in the economic analysis and project design. The current 23% of the installed capacity or 12% of the total design capacity utilized may increase, but that is likely to require additional investments which themselves would need to be assessed for the costs and benefits.

**Table 1: Industrial Value Growth and Water Consumption by Sector**

Industry	Item	Unit	1993	2002	Annual % Rate of Change
Iron/steel	GDP	RMB million	4,524.34	11,964.06	9.2
	Water consumption	million m <sup>3</sup>	53.82	45.23	-1.6
	Water consumption/GDP	m <sup>3</sup> /RMB million	1.19	0.38	-9.9
Electricity	GDP	RMB million	506.28	1,252.98	8.6
	Water consumption	million m <sup>3</sup>	44.52	53.63	1.7
	Water consumption/GDP	M <sup>3</sup> /RMB million	8.79	4.28	-6.3
Coal	GDP	RMB million	1,887.84	946.73	-6.1
	Water consumption	million m <sup>3</sup>	24.24	7.37	-10.3
	Water consumption/GDP	m <sup>3</sup> /RMB million	1.28	0.78	-4.4
Chemical	GDP	RMB million	2,329.08	11,930.29	16
	Water consumption	million m <sup>3</sup>	43.88	36.72	-1.6
	Water consumption/GDP	m <sup>3</sup> /RMB million	1.88	0.31	-15.2
Other <sup>1</sup>	GDP	RMB million	7,183.77	11,930.29	5.8

	Water consumption	million m <sup>3</sup>	65.48	36.72	-6.2
	Water consumption/GDP	m <sup>3</sup> /RMB million	0.91	0.31	-11.4
	GDP	RMB million	17,223.08	3 0,575.66	6.6
	Water consumption	million m <sup>3</sup>	273.53	164.18	-5.5
<b>Total</b>	Water consumption/GDP	m <sup>3</sup> /RMB million	1.59	0.54	-11.4

**Source:** Shanxi Provincial Statistics Bureau.

<sup>1</sup> Mainly including small scale industries and township and village enterprises (TVEs)

9. Given the considerable over design in capacity it is obvious that the project cannot be cost effective as capacity utilization is some 23%. Moreover, more rigorous ex-post cost effectiveness analysis cannot be undertaken as there were no baseline unit rate norms established at SAR to compare with. However, if the full capacity of the scheme is eventually utilized, a reasonable degree of cost-effectiveness would be achieved as (a) it was selected among numerous alternatives, and (b) the technologies adopted and procurement process were in keeping with best construction practices at that time. Given the present situation, where the capacity of the SMT is significantly under-utilized due to over estimated demand (23% of installed capacity or 12% of total design capacity), it is essential that the coverage for transferred water be expanded beyond Taiyuan to enhance cost effectiveness. This has already been recognized by Government and a decision has been made to expand coverage to peri-urban areas around Taiyuan and other industrial and urban centres in central Shanxi along the SMT. However, no feasibility studies, investment and business plans have so far been developed for the expansion, which makes any further economic analysis impossible”.

## Financial Analysis

10. The methodology adopted at appraisal for water pricing was based on the following: (a) obtaining annual capital requirements; (b) determining financing plans; (c) calculating total project cost by appropriate cost allocations (cost sharing); (d) forming necessary operational and financial assumptions; and (e) setting up water tariffs based on a minimum debt coverage ratio of 1.2 or a minimum rate of return on fixed assets in service of 2 percent, whichever gives a greater tariff, to make the YRDPC financially sustainable and to provide an assurance of cost recovery and debt repayment. This clearly represents a fully commercialized business model, which was not workable under the project.

11. The *prima facie* rationale for the WWTP was the provision of water for basic needs and public goods. As such, the YRDPC clearly should not have been treated as a conventional revenue-generating and profit-making entity and, consequently, the financial analysis at both project and entity level is not applicable.

12. In light of this, the business and water-pricing models used at appraisal were not only inappropriate but in fact impeded the achievement of key PDOs. The practice of pricing on the basis of full cost recovery advocated at appraisal has led to a bizarre situation where the provincial government (having paid for the investment) also subsidizes the YRDPC for depreciation.

13. The correct approach, recognizing the “public good” nature of the project, should have been to price diverted water lower than the prevailing price of ground-water as an entry point to facilitate substitution. Once this had occurred and the use of ground-water had been curtailed to safe and sustainable levels, prices could have been increased gradually to cover O&M costs. By focusing on commercialization and full cost pricing from the onset, however, the project has had exactly the opposite effect where significantly cheaper ground-water continues to be over-exploited, effectively crowding out the demand for diverted water.

14. The Government has recognized the apparent anomaly of using full cost recovery as the basis for water pricing and, accordingly, under the Governor's Decree 108, this practice has been abolished.

## Annex 4. Bank Lending and Implementation Support/Supervision Processes

### (a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
<b>Lending</b>			
<b>Supervision/ICR</b>			
Yi Dong	Sr. Financial Management Specialist	EAPCO	
Prem C. Garg	Director	QAG	
Zong-Cheng Lin	Sr. Social Development Spec	EASCS	
Douglas C. Olson	Lead Water Resource Specialist	LCSEN	
Geoffrey Spencer	Sr. Irrigation Engineer	EASRE	
Xiuzhen Zhang	Program Assistant	EACCF	

### (b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	(US\$ thousands including travel and consultant costs)
<b>Lending</b>		
FY94		1.31
FY95		174.26
FY96		246.60
FY97		155.26
FY98		3.93
FY99		0.00
FY00		0.00
FY01		0.00
FY02	1	0.72
FY03		0.00
FY04		0.00
FY05		0.00
FY06		0.00
FY07		0.00
<b>Total:</b>	1	582.08
<b>Supervision/ICR</b>		
FY94		0.00
FY95		0.00
FY96		0.00
FY97		0.00
FY98		157.50
FY99		102.88
FY00	16	77.32
FY01	9	55.50
FY02	28	77.95
FY03	23	47.49

FY04	11	19.10
FY05	9	11.52
FY06	8	20.12
FY07	15	32.74
<b>Total:</b>	119	602.12

**Annex 5. Beneficiary Survey Results (if any)**

NA

**Annex 6. Stakeholder Workshop Report and Results (if any)**

NA

## Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR



### 山西省万家寨引黄工程总公司

Shanxi Wanjiashai Yellow River Diversion Project Corp.

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中国·山西·太原市南内环街217号 No.217, Nanneihuan street, Taiyuan, Shanxi, P. R. China

To: Mr. Jiang Liping  
Project Manager  
the World Bank Office in Beijing

Fax: 010-58617800  
Tel: 010-58617683

From: Mr. Jian Ershuan  
President  
YRDPC

Fax: 0351-4132517  
Tel: 0351-2285197

Date: December 18, 2007

Ref No: YRDPC/007/2007

**Subject:** YRDPC's Comments on the *Implementation Completion and Results Report* for Wanjiashai Water Transfer Project Prepared by the World Bank

#### The World Bank Office in Beijing,

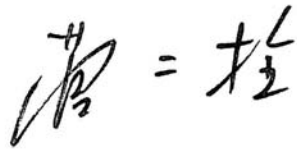
Your Implementation Completion and Results Report (draft) (hereinafter called the Report) for Wanjiashai Water Transfer Project has been received on December 6 of 2007. Our corporation has made careful review to the Report and also solicited opinions of Shanxi Provincial Finance Bureau. The Report has made an overall and objective evaluation on the implementation and achievement of Shanxi Wanjiashai Water Transfer Project. After careful study, we consider that during the preparation period, medium-term adjustment period and overall implementation period of the project, the Borrower has adopted a number of feasible and effective measures to improve organization and management institution, strengthen project construction progress, control construction quality, ensure supporting fund, and properly solve various complicated problems about resettlement, which have ensured the smooth progress of whole project and achieved remarkable results. And, during the preparation and implementation period of the project, with scientific assessment and proof, the World Bank has discovered and helped solving a lot of key problems that might affect implementation of the project. And the World Bank has played a very important role in promoting the project to be completed on schedule and making the

investment yield well. The overall realization of the construction objectives of Shanxi Wanjiazhai Water Transfer Project mainly owes to Shanxi Province's high attention to this project, YRDPC's fruitful efforts and World Bank's active promotion.

Therefore, the World Bank should rate the overall performance of the Borrower of Shanxi Wanjiazhai Water Transfer Project as "very satisfactory" instead of "moderately satisfactory", rate the overall performance of the World Bank as "satisfactory" instead of "moderately unsatisfactory", rate outcomes of the project as "satisfactory" instead of "moderately unsatisfactory".

Attachment: Statements on the reasons for revising the evaluation results to the Borrower's performance, the Bank's performance and the outcomes of the project.

Yours Sincerely,

A handwritten signature in black ink, consisting of stylized Chinese characters, followed by an equals sign and the characters '栓' (shuān), which is the surname of the signatory.

Jian Ershuan

President of Shanxi Yellow River Diversion Project Corporation



## **Annex 8. Comments of Co-financiers and Other Partners/Stakeholders**

NA

## **Annex 9. List of Supporting Documents**

1. QAG evaluations of Quality at Entry and Supervision
2. Aide-Mémoires and related Annexes prepared by the supervision missions
3. Aide-Mémoire and related Annexes of the ICR mission
4. Government ICR
5. Economic Analysis (Excel files)

